Visualization is Alive and Kicking

Arie Kaufman[1]

Computer visualization (or in short *visualization*) is a relatively new field of computer science, yet, it has made a substantial impact since its formal birth in the late eighties. In part, this success has to do among other reasons with the fact that visualization, especially in support of biomedical applications, has been in existence since the seventies, and with a booming progress in its sister field of computer graphics, in terms of hardware, algorithms, and related technologies. Note that I used the term computer visualization to distinguish it from traditional visual display which existed since the creation of mankind. I also didn't use the term scientific visualization, used by the 1987 NSF report on ViSC: "Visualization in Scientific Computing," as to be all inclusive. I further argue that visualization is a discipline, though at its infancy. It combines analysis and synthesis of visual computing and spans an array of techniques, technologies, and applications. Yet, there is a long way to a mature discipline and introspection is paramount at this juncture. The fact that visualization is teaming up with applications gives it the potential to revolutionize many of these applications.

What are the scientific challenges and prospects in the field of visualization?

1. **Visualization paradigms and strategies:** Visual representation; Visualization grids; Abstract data-structures; Hybrid visualization**;** Visual quality and realism; Multi-resolution approaches; Visualization pipeline; Foundations of visualization
2. **Visualization as an interdisciplinary field:** Integrated with the application**;** Coupling modeling, simulation and visualization**;** Integrating visualization into sampling devices
3. **Visualization spaces:** Multi-field, multi-dimension, multi-value, multi-channel, multi-modal**;** Time-dependent data**;** Marriage among data space, feature/information space, alternative space (frequency, compression, wavelet, reciprocal, etc.)**;** Integrated *Visualization Spaces*
4. **Accelerated visualization and engines:** Real-time interaction**;** Special-purpose hardware**;** GPU-based visualization**;** Visualization clusters and grids**;** Distributed and parallel visualization; Portable visualization
5. **Computer human interaction and perception:** Real-time interactive visualization; Visualization steering – "Visualization Cockpit"; Navigation; Virtual and augmented reality; Haptics and other senses; Virtual space "sculpting"; Physically-based interaction; Parameter (e.g., transfer function) selection; Effective application specific user interface; Human factor and perception considerations
6. **Segmentation and detection:** Application-specific auto-segmentation**;** Detection of features and abnormalities; Tera-scale visualization; Feature tracking
7. **Verification, evaluation and testing:** "Clinical" studies for all visualizations; Experimental discipline; Quantitative accuracy; Error analysis and error visualization; Visualization of uncertainty

[1] Leading Professor and Chair, Computer Science Department, Stony Brook University, Stony Brook, NY 11794-4400, ari@cs.sunysb.edu, http://www.cs.sunysb.edu/~ari/